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A Study on the Effect of Lecture and Multimedia Software on Drug Calculation and Prescription: A Systematic Review

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Abstract

Objective: Medication errors can be a risk factor undermining the patient's health, giving rise to irreparable consequences. The medication errors involve miscalculation of drug dosages by nurses and nursing students.

Methods: This study employed several databases including Google Scholar, PubMed and Scopus. For this purpose, the keywords were relevant to virtual learning, electronic learning, learning through lecture, blended learning, online learning, distance education, nursing education, multimedia learning, and teaching aids. The search results were not limited in terms of time.

Results: Lack of knowledge and skills in pharmacology and miscalculations are the major factors contributing to medication errors by nurses and nursing students. Moreover, poor basic knowledge of mathematics among the nursing students can lead to numerous mistakes. The results of previous studies have indicated that blended learning can have a positive impact on learning progress among nursing students. However, some studies have suggested that multimedia tools and teaching aids leave little impact on learning.

Conclusion: It is suggested that the correct adoption of blended learning methods can improve the nursing education in terms of drug calculations.

Keywords: Drug calculations, Multimedia software, Lecture, Principles of drug administration

Introduction

One of the essential duties of every nurse and nursing students in general (1,2) is to carefully follow the patients' medication orders. They should be able to correctly and accurately calculate the dosages and infusion rates of prescription medications as well as to safely follow the medication orders (3). Thus, they require sufficient knowledge and skills in various areas such as familiarity with all kinds of diseases, pharmacology and mathematical calculations (4).

Students are educated usually through different techniques. In this regard, multimedia software and lectures are broadly adopted within the Iranian education system. This type of e-learning is an interactive method using computers based on educational software applications as well as the Internet, various software programs, instructional videos and so on. This type of learning can take place via electronic media, World Wide Web, virtual space and distance learning as well as in-person software-assisted learning. In fact, the educational content is delivered to learners through images, audios, texts, and instructional videos, where the teacher-learner interactive communication can improve the quality of education (5).

Given their time and space constraints as well as high costs, traditional training needs to be replaced by alternative methods not requiring the physical presence of teachers and students in the classroom (6). The modern methods such as e-learning and training by teaching aids have been proposed so as to tackle the limitations of traditional education, thanks to the growth of information technology and electronic devices (7-9). E-learning involves the use of electronic media devices and communication technologies (10). The educational materials can be delivered to students through network-based media tools, multimedia systems, CDs and DVDs, videotapes, animated movies, video conferencing and websites (7-11).

Distance learning has several disadvantages such as poor social interaction between teachers and students, poor control over student behavior and the risk of cheating. Furthermore, students will have no instant and direct access to the instructors (12,13). In view of the above disadvantages as well as the need for in-person training particularly in nursing education, blended e-learning and face-to-face method can bring about ideal efficiency. This type of blended learning is commonly adopted (14,15). As a result, learners will benefit from the advantages of both

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methods (16,17). Blended learning can be implemented through different strategies according to the needs of learners. For instance, there are a variety of lectures, workshops, online training and simulation training and other communication tools (18). One of the teaching techniques involves computers encouraging the participation of students (19-21). Blended learning is highly context-dependent therefore generalization of concepts across disciplines is challenging (22). Numerous studies have been indicated the poor drug calculation ability of both student and nurses (23-26). However, few studies have assess strategies designed to improve their ability. Nurses will therefore need to have learnt and retained calculation skills in order to perform them accurately over irregular periods. The aim of this systematic review was to determine the adoption of lecture and multimedia tools in education.

Methods

This study employed Systematic literature searches of several databases including Google Scholar, PubMed and Scopus. For this purpose, the keywords were relevant to virtual learning, teaching aids and blended learning. The search results were not limited in terms of time. The keywords included virtual learning, electronic learning, learning through lecture, blended learning, online learning, distance education, nursing education, multimedia learning. Finally, 59 articles were included in this study, 9 articles that had not randomized controlled trials were excluded of this research and dates of 50 articles used as references ranged from 1994-2015.

Results

Pharmacology and Drug Calculating Skills

Lack of knowledge and skills in pharmacology and drug miscalculations are the factors contributing to medication errors (27). It can prolong hospitalization, increase costs and sometimes lead to severe, irreparable damage and even patient's death (28). Moreover, medication errors are a common serious problem in any hospital (29). The US National Academy of Medicine has reported that 98 000 people die because of medical errors annually, of which is 7000 cases are due to medication errors. In other words, one out of every 10 hospitalized patients in the United States suffers from the damage caused by medication errors. In fact, medication errors are the eighth leading cause of death in the United States (30). According to the studies done in Europe, 19% to 28% of patients are at risk (27).

Due to reporting obstacles, there is inadequate data concerning the number of medication errors committed by nurses in Iran. However, it seems the figure would be extremely large. In one study, the incidence of medication errors by nurses working in a hospital in Kermanshah was reported to be 79.2% (31).

Although the lack of knowledge and skills in pharmacology and drug miscalculations are the major causes of medication errors by nurses and nursing students, it seems little attention has been paid to the BSN syllabi in Iran. This is especially important in the case of life-saving drugs (27). According to a study by Ahmadieh and Dehqanpoor, nursing students have difficulty in drug calculations due to poor math skills, which can be tackled within one of the educational courses (32). In one study, nursing students pointed out poor pharmacologic knowledge, insufficient teaching time and failure of curriculum to comply with their practical requirements (27). Based on the results of these studies, it can be concluded that the prevalence of medication errors is high among nurses and nursing students, making it crucial to pay special attention to the educational courses.

In another study, the frequency of medication errors was reported to be 48.5% (27). In their study on 110 nurses aimed at assessing the ability to calculate the drug dosages, Bindler and Bayne (33) found that 81% of nurses scored below 90 and 43.6% scored below 70. Moreover, Gladstone (34) found that more than 50% of medication errors concern dosage, of which 30% are associated with miscalculation of amount or infusion rate (34,35).

Gillham and Chu (36) assessed the ability to calculate drug dosages among 158 nursing sophomores through a questionnaire consisted of 10 items. In this study, only 55% of students responded correctly to all items. It was found that the poor basic math knowledge among students was one of the factors contributing to numerous mistakes.

According to another study, poor pharmacological knowledge was the most important factor leading to wrong prescription of intravenous drugs by newly graduated nurses in Japan (27). The study by Zahmatkeshan et al (38) and Nick Pima and Gholamnejad (36) reflected the prevalence of miscalculation of drug dosage among nurses. In a study by Wright (39) to assess the level of comprehension and skills in mathematical calculation among nursing sophomores through a self-structured questionnaire and math test, the results indicated that students were extremely poor in basic math calculations. According to Shams et al, the pharmacological knowledge of heart drugs calculation skills among nursing students was unacceptable (40). Similarly, Koohestani et al suggested that heart drugs miscalculation wasthe most common medication error among nursing students (27). In their study on assessing the basic skills in medication and intravenous treatments among third-year nursing students, Haji Hosseini et al demonstrated there was minimal skills in calculating the drug dosages and serum drops (41).

Some researchers have argued that the knowledge and skills of nurses diminish, thus requiring re-training of courses (42). The results of previous studies have shown that the mistakes made by students are often due to simple medication errors. Of the 19 sophomore nursing students who had failed in the first test, only 3 cases committed errors after re-training. In the third round of re-retraining, all students made correct dosage calculations. The results of above study showed that repeated training can be effective in reducing nursing errors (34).

The reports suggest that the most common causes of medication errors are poor pharmacological knowledge (15.25%), negligence about the drug dosage on the

pharmaceutical card (13.55%) and drug miscalculations (11.86%). In another study, poor pharmacological knowledge (26.52%) was pointed out as a common cause of medication errors committed by nursing students (43).

Teaching method

Lectures

Education can provide the students with learning opportunities in all areas such as cognitive, attitudinal and psychomotor skills as well as personality development. In this regard, one of the major challenges of nursing education is how to train students highly skilled in providing effective services in the actual clinical settings (44). Based on the evidence, lecturing is currently the most adopted method for teaching pharmacology (45). However, the pharmacological knowledge and skills are not at the desired level among nursing students. It is inevitable to train students on more efficient strategies prior to engagement in the clinical settings (45), since previous research indicates that poor knowledge of medication calculations become evident when the nursing students begin to work in an actual clinical environment, where students during clinical internships are directly in touch with patients, and any slightest error might lead to irreparable complications and even death of patients.

Lecturing is an ancient method of teaching. It is teacher-centered, leaving students passive and neglected in terms of individual differences. Although lecturing is the best teaching method in certain occasions (46), many studies reported that learner-centered methods are superior (47). According to theorists, teaching through common methods is no longer effective due to time and place restraints (44). On the other hand, attending the classes require students and teachers to travel more frequently and pay for higher costs (42).

Owing to the evolutionary advances in technology over the last few decades, it seems inevitable to adopt the new teaching methods and revise the current practices in various disciplines including medical sciences (46). Moreover, nursing and its education method should adapt to such changes (20). Given the growing number of nursing students and the inadequacy of instructors at nursing schools, it is crucial to adopt alternative methods to lecture (20).

E-learning and Multimedia

There are several modern teaching e-learning methods involving instructional software applications based on IT tool such as computers, the Internet, mobile phones etc (46). The use of computers as the primary means of teaching is known as computer assisted instruction (CAI). The CAI is delivered via the Internet, World Wide Web, satellite broadcasting, multimedia software, virtual learning, distance learning and computer simulations (42).

According to Cantrell et al, the effectiveness of CAI lies in the audio communication between learners and instructors (42,48). The integration of video, pictures and animation with textbook materials can boost the interest in learning and strike a balance between visual, written and auditory aspects of learning (44). It can be argued that multimedia software applications as an integral element of e-learning (5) serve to develop the clinical skills and enhance decision-making among nursing students (49). On the other hand, this method can set the ground for learning proportionate to individual talents (42).

Although there are studies highlighting the more effective role of media-assisted instruction, certain studies have argued that the impact is not greater than that of other teaching methods. In their study on training electrocardiography skills, Jeffrise et al found out there was no significant difference between the two groups receiving multimedia courses and the common method (50). Moreover, Sung et al conducted a comparative study on the effect of training oral drug prescription through a common method and multimedia method. They found out there was no significant difference between the two groups, even though the subjects in the multimedia group were more satisfied (42,51). In another study, it was demonstrated that the satisfaction and performance score of the group trained through online courses, videos and multimedia reflected better clinical skills than the control group (52). The results obtained by Ma et al indicated that the use of instructional videos in teaching physical examination can improve practical skills more efficiently than traditional methods (53). In fact, instructional videos significantly improved the knowledge practical skills of final-semester nursing students compared to the control group (53).

According to previous studies, learning progress in the electronic method is greater than the lecture method by 20% to 30% (46). However, some experts believe that e-learning is complementary to conventional teaching methods (42), raising the concept of blended learning. Assuming that multimedia design for improvement of learning is more compatible with human performance than other methods, it is vital for educational planners to adopt the human-oriented practices in the design of multimedia programs.

Because of its focus on the use of technology to aid human cognition. After all, such programs utilize the modern technology to help foster the human cognitive skills. Although there are various theories of learning in cognitive, structural and behavioral terms, the multimedia aspect of learning has been concerned only by the cognitive theory (54,55).

According to Kim et al, the use of CDs in teaching students can create more motivation than paper textbooks (56). In their study, Khakbazan et al found a significant increase in the post-training knowledge in the software package group compared to the lecture group (42.57). The results of another study suggested that the use of educational software together with instructional videos significantly improved the grades, whereas the control group showed no improvement through traditional training practices ($P > 0.05$) (44).

Aiming to compare the dosage calculation training of two groups through lecture and other strategies such as online math learning and face-to-face training, the results of a

review study indicated that the alternative strategies were more effective in improvement of drug calculations and skills sustained for more than 12 months with an emphasis on mathematical skills and conceptualization. In addition to mathematical knowledge, correct calculation of drug dosages requires conceptualization and interpretation skills (39).

Concerning the instructions to nurses on how to follow drug orders, the combination of face-to-face training and e-learning enhanced their medical and pharmacological knowledge (21). In another assessment on the skills to control vital signs through multimedia devices and use of anatomy and physiology content, the practical skills of the students improve, even though there was little change in their actual knowledge (46). Yet, the results of another study in conjunction with the clinical skills of nursing students demonstrated that instructional videos could best complement the lecture method, even though it was barely a perfect alternative (44). Moreover, Nusir found no statistically significant difference between the two groups learning through lecture and multimedia devices (42,57). The advantages of this method include flexibility, active learning, feedback and repeatability of educational programs (54).

Discussion

Learning the practical skills prior to employment in actual settings is a key issue in nursing care. The results of previous studies suggested that novice nurses and nursing students may have difficulty in proper care of the patients and therefore miscalculate the drug dosages. The mastery of practical skills in students should be realized conveniently by nursing students in actual settings. One modern educational strategy involves multimedia software and instructional videos.

It is crucial to train nurses more efficiently given the prevalence of medication errors aligned with risk management and quality improvement in hospitals (21). Furthermore, it seems vital to carry out further study to resolve the previous inconsistencies and compare the efficacies of various teaching methods for nurses and nursing students. In addition, most of the previous studies did not adequately explore the CAT programs, which are generally not designed based on learning principles.

Ethical Issues

Not applicable.

Conflict of Interests

None to be declared.

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